WHAT IS CLAIMED IS:

1. A method for computing a natural logarithm function comprising the steps of:

Sub A4

partitioning a mantissa region between 1 and 2 into N equally spaced sub-regions;

precomputing centerpoints a_i of each of the N equally spaced sub-regions, where $i = 0, \ldots, N-1$;

selecting N sufficiently large so that, for each sub-region, a first degree polynomial in m computes $\log(m)$ to within a preselected degree of accuracy for any m within the sub-region, where m is a binary mantissa of a binary floating point representation of a number; and

computing a value of $\log(x)$ for a binary floating point representation of a particular number x stored in a memory of a computing device utilizing the first degree polynomial in m.

Sub B1

2. A method in accordance with Claim 1 wherein the particular number x has a binary exponent e in addition to the binary mantissa m;

and further wherein computing a value of $\log(x)$ for the binary floating point representation of the particular number x comprises the steps of:

partitioning a mantissa m of a binary representation of x in a memory, the representation of x including a binary exponent e and the binary mantissa m, wherein a first, most significant part of the partition corresponds to a region i and a second, less significant part of the partition corresponds to a region Δx, where Δx is a distance from mantissa m to reference point $a_i = 1 + \frac{i + 0.5}{N}$; and

computing an approximation to $\log(x)$, using a polynomial of first degree in m and a precomputed value of $\log(a_i)$.

3. A method in accordance with Claim 2 wherein computing the approximation to log(x) comprises the step of computing an approximation written as:

$$\log(m) \approx \log(a_i) + \frac{(m - a_i)}{a_i};$$

where a_i is a closest reference point to the binary mantissa m of the number x; and

$$1 \le a_i < 2.$$

4. A method in accordance with Claim 2 wherein computing an approximation to log(x) comprises the step of computing an approximation written as:

Sub A5

$$y = -\log(x) \approx b_i + c_i \Delta x + e \times \log(2)$$

for $i = 0, \ldots, N-1$

where:

$$b_i = -\log(a_i) + \left(\frac{1}{4a_i N}\right)^2 - \left(1 + \frac{1}{2N}\right)\frac{1}{a_i}; \text{and}$$

$$c_i = -1/a_i.$$

5. A method in accordance with Claim 4 further comprising the steps of precomputing a value for log(2), and, for each i, precomputing each value of b_i and c_i.

6. A method in accordance with Claim 5 further comprising the step of storing the precomputed values of b_i and c_i in a look-up table.

7. A method in accordance with Claim 2 wherein the number x is represented by a 32-bit representation having a sign bit, an 8-bit exponent, and a 23-bit binary mantissa m having bits b_{22} to b_0 in order of significance with b_{22} being a bit of greatest significance; and the step of partitioning the mantissa m comprises the

Dub E1 step of selecting a first ~~group of~~ bits b_{22} through b_{16} as index i and bits b_{15} through b_0 as Δx.

Dub B3 8. ~~A method~~ in accordance with Claim 1 utilized in a computed tomography (CT) scanner for generating ~~an image~~ of an object from acquired projection data of the object.

Dub E1 9. A method in accordance with Claim 8 wherein said natural logarithm is used in an image reconstructor to generate the image of the object.

10. A method in accordance with Claim 8 wherein the particular number x has a binary exponent e in addition to the binary mantissa m;

and further wherein computing a value of $\log(x)$ for the binary floating point representation of the particular number x comprises the steps of:

partitioning a mantissa m of a binary representation of x in a memory, the representation of x including a binary exponent e and the binary mantissa m, wherein a first, most significant part of the partition corresponds to a region i and a second, less significant part of the partition corresponds to a region Δx, where Δx is a distance from mantissa m to reference point $a_i = 1 + \frac{i + 0.5}{N}$; and

computing an approximation to $\log(x)$, using a polynomial of first degree in m and a precomputed value of $\log(a_i)$.

11. A method in accordance with Claim 10 wherein computing the approximation to $\log(x)$ comprises the step of computing an approximation written as:

$$\log(m) \approx \log(a_i) + \frac{(m - a_i)}{a_i};$$

where a_i is a closest reference point to the mantissa m; and

$1 \le a_i < 2$.

Sub A6

12. A method in accordance with Claim 10 wherein computing an approximation to log(x) comprises the step of computing an approximation written as:

$$y = -\log(x) \approx b_i + c_i \Delta x + e \times \log(2)$$

for $i = 0, \ldots, N-1$

where:

$$b_i = -\log(a_i) + \left(\frac{1}{4a_i N}\right)^2 - \left(1 + \frac{1}{2N}\right)\frac{1}{a_i}; \text{and}$$

$$c_i = -1/a_i.$$

13. ~~A method in accordance~~ with Claim 12 further comprising the steps of precomputing a value for log(2), and, for each i, pre~~comput~~ing each value of b_i and c_i.

14. A method in accordance with Claim 13 further comprising the step of storing the precomputed values of b_i and c_i in a look-up table.

15. A computing device comprising a memory in which binary floating point representations of particular numbers are stored, said device being configured to:

partition a mantissa region between 1 and 2 into N equally spaced sub-regions;

precompute centerpoints a_i of each of the N equally spaced sub-regions, where i=0,...,N-1, wherein N is sufficiently large so that, within each sub-region, a first degree polynomial in m computes log(m) to within a preselected degree of accuracy for any m within the sub-region, where m is a binary mantissa of a binary floating point representation of a number; and

compute a value of log(x) for a binary floating point representation of a particular number x stored in said memory utilizing the first degree polynomial in m.

Sub E_1

16. A computing device in accordance with Claim 15 wherein the particular number x has a binary exponent e in addition to the binary mantissa m;

and wherein said device being configured to compute a value of $\log(x)$ for the binary floating point representation of the particular number x comprises said device being configured to:

partition a mantissa m of a binary representation of x in a memory of said device, the representation of x including a binary exponent e and the binary mantissa m, wherein a first, most significant part of the partition corresponds to a region i and a second, less significant part of the partition corresponds to a region Δx, where Δx is a distance from mantissa m to reference point $a_i = 1 + \frac{i + 0.5}{N}$; and

compute an approximation to $\log(x)$, using a polynomial of first degree in m and a precomputed value of $\log(a_i)$.

17. A computing device in accordance with Claim 16 wherein said device being configured to compute the approximation to $\log(x)$ comprises said device being configured to compute an approximation written as:

$$\log(m) \approx \log(a_i) + \frac{(m - a_i)}{a_i},$$

where a_i is a closest reference point to the binary mantissa m of the number x; and

$$1 \le a_i < 2.$$

18. A computing device in accordance with Claim 16 wherein said device being configured to compute an approximation to $\log(x)$ comprises said device being configured to compute an approximation written as:

Sub A7

$$y = -\log(x) \approx b_i + c_i \Delta x + e \times \log(2)$$

Cont. Sub A17

for $i = 0,\ldots,N-1$

where:

$$b_i = -\log(a_i) + \left(\frac{1}{4a_i N}\right)^2 - \left(1 + \frac{1}{2N}\right)\frac{1}{a_i}; \text{and}$$

$$c_i = -1/a_i.$$

Sub B5

19. ~~A computing~~ device in accordance with Claim 18 further configured to precompute a value for log(2), and, for ~~each i, to~~ precompute each value of b_i and c_i.

20. A computing device in accordance with Claim 19 further configured to store the precomputed values of b_i and c_i in a look-up table.

21. A computing device in accordance with Claim 16 wherein the number x is represented by a 32-bit representation having a sign bit, an 8-bit exponent, and a 23-bit binary mantissa m having bits b_{22} to b_0 in order of significance with b_{22} being a bit of greatest significance; and wherein said device being configured to partition the mantissa m comprises said device being configured to select a first group of bits b_{22} through b_{16} as index i and bits b_{15} through b_0 as Δx.

22. A computing device in accordance with Claim 15 in a computed tomography (CT) scanner and utilized by said CT scanner for calculating logarithms when said CT scanner generates an image of an object from acquired projection data of the object.

23. A computing device in accordance with Claim 22 wherein said CT scanner utilizes said computing device to calculate natural logarithm in an image reconstructor to generate the image of the object.

24. A computing device in accordance with Claim 22 wherein the particular number x is stored with a binary exponent e in addition to the binary mantissa m;

Sub E2

and further wherein said device being configured to compute a value of log(x) for the binary floating point representation of the particular number x comprises said device being configured to:

partition a mantissa m of a binary representation of x in a memory, the representation of x including a binary exponent e and the binary mantissa m, wherein a first, most significant part of the partition corresponds to a region i and a second, less significant part of the partition corresponds to a region Δx, where Δx is a distance from mantissa m to reference point $a_i = 1 + \frac{i+0.5}{N}$; and

compute an approximation to log(x), using a polynomial of first degree in m and a precomputed value of log(a_i).

25. A computing device in accordance with Claim 24 wherein said device being configured to compute the approximation to log(x) comprises said device being configured to compute an approximation written as:

$$\log(m) \approx \log(a_i) + \frac{(m - a_i)}{a_i};$$

where a_i is a closest reference point to the mantissa m; and

$1 \le a_i < 2$.

26. A computing device in accordance with Claim 24 wherein said device being configured to compute an approximation to log(x) comprises said device being configured to compute an approximation written as:

Sub A8

$$y = -\log(x) \approx b_i + c_i \Delta x + e \times \log(2)$$

for $i = 0, \ldots, N-1$

where:

Cont. Sub A8

$$b_i = -\log(a_i) + \left(\frac{1}{4a_iN}\right)^2 - \left(1 + \frac{1}{2N}\right)\frac{1}{a_i}; \text{ and}$$

$$c_i = -1/a_i.$$

Sub B6

27. ~~A computing device in~~ accordance with Claim 26 further configured to precompute a value for log(2), and, for each i, to preco~~mpute~~ each value of b_i and c_i.

Sub E1

28. ~~A~~ computing device in accordance with Claim 27 further configured to store the precomputed val~~ues of~~ b_i and c_i in a look-up table.

add A9

add B8

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